Production of light charged and neutral particles in the proton and alpha induced reactions on ^{nat} Si target between 20 and 65 MeV

Christophe Dufauquez, Youssef El Masri, Juan Cabrera, Vincent Roberfroid, Thomas Keutgen, Alain Ninane, Jos Van Mol

Institute of Nuclear Physics of the catholic University of Louvain, Louvain-la-Neuve, Belgium

Destructive and upsetting effects of impinging nuclear radiation (from radioactive sources or particle beams) and cosmic-rays on natural silicon, principal constituent of semi-conductor detectors or electronic devices incorporated in the microelectronic of space and avionic systems, are presently of current interest for industrial and safety applications.

Then it became urgent to build a large and accurate data base for neutral and charged particles basic and microscopic interactions in ^{nat} Si through in-beam experiments in order to obtain a realistic interaction scheme to improve the existing models and their capabilities to reproduce and understand the observed phenomenon in electronic subsystems such as "single event upset".

Therefore we undertook such studies at the Louvain-la-Neuve cyclotron facility using proton and alpha beams of energies ranging between 20 and 65 MeV in order to provide inclusive data such as: $\frac{d^2\sigma}{d\Omega dE}$, $\frac{d\sigma}{dE}$, $\frac{d\sigma}{d\Omega}$ and σ_{tot} cross-sections of all possible secondary neutral and light charged (LCP) emitted particles (n, p, d, t, ^3He, ^4He, Li and Be).

Detection of the LCP was achieved by using a set of several Si triple-telescopes and Si-Si-CsI telescope assemblies. Neutron detection was insured by the 96 DEMON large volume liquid scintillation counters surrounding the reaction chamber at two meters distance-of-flight from the target. This experimental set-up has allowed i) an excellent identification of the different light and neutral particle species (in Z and A) and ii) the measurements of their energies and angular distributions.

We will report on the presently available results and their interpretation with a confrontation to predictive model codes such as GNASH and ICM [1,2].

[1] International Commission on Radiation Units and Measurements, ICRU report 63, Maryland, USA.

[2] J. Cugnon and P. Henrotte, 2000, The Liège Intranuclear Cascade Model, Proceedings of the SARES Meeting, OECD Publications, Paris.

Email: dufauquez@fynu.ucl.ac.be